NAVAL WAR COLLEGE
Newport, Rhode Island

C^4I FOR THE WARRIOR:
Avoiding "Nose-in-the-Cockpit" Syndrome

by

David J. Aland
Commander, United States Navy

A paper submitted to the Faculty of the Naval War College in partial satisfaction of the requirements of the Joint Military Operations course.

The contents of this paper reflect my own personal views and are not necessarily endorsed by the Naval War College or the Department of the Navy.

16 May 1995

Paper directed by
Captain David Watson, United States Navy
Chairman, Joint Military Operations Department

15 MAY 95

Faculty Advisor Date
Captain Eugene Nielsen, USN
Admiral Raymond A. Spruance
Chair for C^4I

REPORT DOCUMENTATION PAGE

1. Report Security Classification: UNCLASSIFIED	
2. Security Classification Authority:	
3. Declassification/Downgrading Schedule:	
4. Distribution/Availability of Report: DISTRIBUTION STATEMENT A: APPROVED FOR PUBLIC RELEASE; DISTRIBUTION IS UNLIMITED.	
5. Name of Performing Organization: JOINT MILITARY OPERATIONS DEPARTMENT	
6. Office Symbol: C	**7. Address:** NAVAL WAR COLLEGE 686 CUSHING ROAD NEWPORT, RI 02841-1207
8. Title (Include Security Classification): "C4I for the Warrior: Avoiding "Nose-in-the-Cockpit" Syndrome (U)	
9. Personal Authors: David James Aland; Commander, USN	
10.Type of Report: FINAL	**11. Date of Report:** 16 May 1995
12.Page Count: 19 pages (3,000 words)	
13.Supplementary Notation: A paper submitted to the Faculty of the NWC in partial satisfaction of the requirements of the JMO Department. The contents of this paper reflect my own personal views and are not necessarily endorsed by the NWC or the Department of the Navy.	
14. Ten key words that relate to your paper: Command, Control, C4I, C2, CINC, Fusion, Infosphere, Warrior, Centralization, Technology	

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16.Distribution / Availability of Abstract:	**Unclassified** X	**Same As Rpt**	**DTIC Users**
18.Abstract Security Classification: UNCLASSIFIED			
19.Name of Responsible Individual: CHAIRMAN, JOINT MILITARY OPERATIONS DEPARTMENT			
20.Telephone: 841-6457		**21.Office Symbol:** C	

TABLE OF CONTENTS

ABSTRACT

New information technologies will provide increased connectivity. The "C^4I for the Warrior" strategy will take advantage of these changes to improve Command and Control (C^2). The C^2 process, both men and machines, gathers and reduces information into usable knowledge. Information overload is an everpresent danger. The "perfect" process will avoid overwhelming the user with data. The "C^4I for the Warrior" strategy is flawed in that it emphasizes connectivity and interoperability at the expense of fusion and correlation. In the past, as seen with the telegraph and the radio, unfettered increases in information flow have led to increased centralization and reduced effectiveness for the commander. The more immediate the data, the more the commander's nose gets "stuck in the cockpit." New systems which have been shaped by the commander needs may inadvertantly affect his leadership style. New systems should avoid altering leadership methods and must have decision-making disciplines built in. Development of fusion, management, and decision-aid software must keep pace with the interconnecting of the information architectures. As the architecture is likely to outpace the development of tools by which it is managed, it is necessary for the operational commander to precisely define his (and his subordinates') volumes of influence.

I. INTRODUCTION

"... when you know sky and earth,
victory is inexhaustible."
-- Sun-Tzu [1]

The technology demonstration was short--a presentation that brought the tactical picture from a battlespace over 3,000 miles away into the Pentagon. On several screens, ships and aircraft were shown conducting offensive operations. In another corner, one of the displays carried real-time periscope images from a submarine operating with the distant force. As two admirals departed the demonstration, one said to the other, "Isn't that the most amazing thing you've ever seen?" Replied the second, "Uh-huh--my worst nightmares have finally come true."[2]

A revolution in military affairs is taking place that mirrors a global phenomenon: information-centered thinking is beginning to displace the more traditional modes of organization and decision-making.[3] Opinions on these changes and the technologies that make them possible vary, ranging from enthusiasm to skepticism. One thing however, is certain: the technologies of this revolution are as irreversible as they are powerful.

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[1] Sun-Tzu, *The Art of War,* Thomas Cleary, trans (Boston: Shambhala Press, 1988), p. 147.

[2] The Joint Tactical Information Distribution System (JTIDS) Pentagon demonstration (12-14 January 1994) was sponsored by the CNO(N6) and the Program Executive Officer for Space, Communications and Sensors, and coordinated by myself and CAPT John T. O'Connell (PMW-159). The demonstration linked a carrier battlegroup exercising in the southern California operating areas (using JTIDS) via satellite to displays in the Pentagon, allowing the attendees to view the battlegroup operations in real time. The anecdotal quotes provided are not attributed as they are meant to be representative of two dominant reactions observed by myself.

[3] Alvin Toffler, *The Third Wave* (New York: William Morrow and Company, Inc., 1980), p. 181.

As the armed forces enter the information age, and strategies such as "C^4I for the Warrior" move from concept to reality, it is essential that we address certain critical questions. The warfighter is poised on the verge of a revolution in the availability of information. Technology may provide instant connectivity to the most detailed and immediate data, but at every level of command the concern should not only be the *how* of it, but the *why*.

In command and control, both *quality* and *quantity* of information are essential issues. This paper will examine the information needs of the operational commander, the impact of the emerging command and control (C^2) architectures at the operational level, discuss some information pathologies made possible by these architectures, and recommend means by which they may be avoided.

II. DEALING WITH UNCERTAINTY

"From Plato to NATO, the history of command in war consists essentially of an endless quest for certainty."
-- Martin van Creveld[4]

Frank M. Snyder states that the logic of C^2 is directly reflected in the military planning process: choosing a course of action, developing a plan, promulgating the plan, and *monitoring the subsequent action.*[5] This process is an iterative loop, where the observational feedback directly impacts the rest of the sequence.[6] Feedback from the battlespace can be both *institutional* (e.g., "source-push" assets inherent in the forces) as well as a personal reaction ("user-pull") to the commander's preferences.[7]

Historian Martin van Creveld refers to commander-specific information gathering as a "directed telescope" through which the commander may "view" portions of the battlespace in greater detail. Such observations allow commanders to view events that have particular significance to them, and amplify/verify the information already flowing (institutionally) from the battlespace.[8] In all cases, ". . . the commander seeks a dynamic image of the battlefield that will lead him to understand what action needs to be taken."[9] This is critical to ensure that the commander can concentrate forces in that time and place that will produce the greatest effect.

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[4] Martin van Creveld, *Command in War* (Cambridge: Harvard University Press, 1985), p. 264.

[5] Frank M. Snyder, *Command and Control: The Literature and Commentaries* (Washington: National Defense University, 1993), p. xiii.

[6] George E. Orr, *Combat Operations C3I: Fundamentals and Interactions* (Maxwell Air Force Base: Air University Press, 1983), p. 85.

[7] Francis W. A'Hearn, *The Information Arsenal: A C3I Profile* (Cambridge: Harvard University Press, Center for Information Policy Research, 1984), p. II-17.

[8] van Creveld, p. 75.

[9] James P. Kahan, D. Robert Worley, Cathleen Stasz; *Understanding Commanders' Information Needs* (Santa Monica: RAND Corporation, 1989), p. vi.

There is a danger in information gathering, and although not new to this era, it is readily apparent in the modern age of communications and computers: information overload. Neil Munro, of *Defense Weekly*, points out:

> It might be assumed that modern communications and computers always quicken response time. But they can in fact slow down command and control times if the commander is overloaded with a torrent of information.[10]

It is therefore incumbent upon the military commander, at tactical, operational, and strategic levels to select carefully not only what information is received at headquarters, but how much. Thus, an efficient C^2 process is a funnel through which information not only passes but is *reduced* (fused and condensed). In other words: "...command and control structures are always pyramidal . . . the information . . . always have (sic) to run up or down, *pyramidally* through the structure."[11]

Major General Welch perceives the "perfect C^3I system" as one that will (1) preserve order within a force, (2) help the commander avoid blunders, (3) ensure "non-zero effectiveness," and (4) enable efficiency.[12] General Colin Powell states the requirement somewhat differently: ". . . a distributed database needs to be created from information provided by all available sources."[13]

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[10] Niel Munro, *The Quick and the Dead: Electronic Combat and Modern Warfare* (New York: St. Martin's Press, 1991), pp. 78-80.

[11] Richard S. Beal from "Decision Making, Crisis Management, Information and Technology", lecture, quoted in Thomas P. Coakley, *Issues of Command and Control*, (Washington: National Defense University, 1991), p. 32. (emphasis is added.)

[12] J. Welch, "C3I Systems: The Efficiency Connection;" quoted in John Hwang, Daniel Schutzer, Kenneth Shere, and Peter Vena, eds., *Selected Analytical Concepts in Command and Control*, (New York: Gordon and Breach Science Publisheres, 1982), pp. 4-6.

[13] Colin L. Powell, "Information Age Warriors," *Byte*, July 1992, p. 370.

This is precisely what the joint "C4I for the Warrior" effort is meant to address: creation of a C^2 process that provides the CINC[14], with *institutional information tools* that also provide a "*directed telescope*" when formulating the dynamic image necessary to all subsequent plans and operations.

[14] Edward Walsh, "An Emphasis on Core Competencies," *Seapower*, April 1995, p. 46 and p. 50.

III. GLOBAL COMMAND AND CONTROL

"...we are looking for the 80 percent solutions...."
-- LGEN Edmonds, USAF[15]

"C4I for the Warrior" is not intended to provide the operational commander with a "perfect" system, but to come close. The Joint Staff has been careful to avoid setting the sights too high, perhaps in recognition of the fiscal and political realities of the '90's. This middle-of-the-road approach to achieving a joint infosphere has three phases: Quick-Fix, Mid-Term, and Objective. The phases are organized around the concept of coordinated migration of C^2 systems to meet the stated goal of the Objective phase: an integrated global infosphere.

In the Quick-Fix Phase, emphasis is connectivity and interoperability. The systems identified are linked together through translators such as "JUDI" (Joint Universal Data Interpreter) and implementation of interoperability doctrines. Systems that cannot conform are to be left behind. This phase is meant to initially alleviate the "babel" of stovepipe information architectures, and the Joint Staff is already declaring victory here.

The Mid-Term phase will allow for systems migrations of "best of breed" capabilities to modular and open-systems architectures, and to capitalize on prior achievements by joining up the interoperating systems into networks and networks-of-networks. The ultimate goal of a fully integrated and fused infosphere in the Objective Phase will be the direct and evolutionary product of these Mid-Term architectures.[16]

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[15] Chairman, Joint Chiefs of Staff, *C4I For The Warrior: Global Command and Control System. From Concept to Reality* (Washington: 1994), p. 2.

[16] ibid., pp. 15-17

Declarations of "victory" may be premature. The "Warrior" strategy depends heavily on continued progress in hardware and software interoperability, and on the willingness of the services to combine efforts rather than compete. Furthermore, the emphasis is on connectivity and interoperability--while data fusion is discussed in the strategy, *it is not addressed as a goal until the third and final phase*. Deferral of information *reduction*, while networking information sources, may create an initial shortfall in the overall strategy: the ability to manage information may be overtaken by the amount of information available.

Data fusion is certainly not left unconsidered. General Powell insists ". . . information must be *fused* and distributed in such a way that it can be pulled from (the) global 'infosphere' on demand."[17] His successor, General Shalikashvili also describes the goal as "producing a global C4I system capable of generating and delivering the *fused* information needed . . ."[18] Precisely *how and when* the data in the global networks will be fused, and to what standards is left unspecified.

We are literally "betting on the come"--hoping to solve the technical hurdles to data fusion as we move forward with interoperability and connectivity. It is almost a classic "chicken-and-egg" dilemma, the "wiring-up" of the architecture will precede the development of the means to manage it, yet without connectivity, there is nothing to manage. But unfettered increases in battlefield data do not come without hazard.

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[17] "Information Age Warriors," p. 370. (emphasis is added)
[18] CJCS, p. 1. (emphasis is added)

IV. "NOSE-IN-THE-COCKPIT" SYNDROME

"Knowledge is good."
-- Motto, "Faber College" [19]

If we accept that knowledge is the product of assessing information, then it might logically follow that more information would produce better knowledge. By this thinking, *quality* would be the direct product of *quantity*.

Irish mythology contains a telling metaphor: the legendary hero, Fibhn MacCumhail ("Fin M^{c}Cool") has been granted two gifts: a ring that speaks, and "perfect knowledge" by simply biting his own fingers. Captured, he blinds his captor and attempts to escape. At a critical juncture however, his captor calls out to the ring, and it answers him, revealing MacCumhails location. MacCumhail bites his own finger off to shed the ring, and is overwhelmed by the flood of knowledge that results.[20]

The operational commander faces the same challenge as the mythological Celt: how much data is enough, and at what price? The history of warfare has many examples of new technologies both assisting or hindering the process of C^2 by increasing data flow. Van Creveld cites two notable innovations, the telegraph and the radio.

Both inventions radically increased the speed and completeness of information to and from the battlefield. The telegraph, used successfully in the late 1800's to support relatively mobile and independent formations, tended during World War I to immobilize both leadership and forces.[21] Similarly, while the German *Wehrmacht* used wireless

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[19] Harold Ramis, Douglas Kenney, and Chris Miller, screenwriters; *National Lampoons Animal House*, Los Angeles CA: Universal City Productions, 1978.

[20] Jeremiah Curtin, Myths and Folk-Lore of Ireland, (n.p., 1890; reprinted ed., New York: Weathervane Books, 1975), pp. 210-213.

[21] van Creveld, pp. 103-188. While Moltke used the newly-invented telegraph to monitor troops that maneuvered in a very flexible operational plan, Haig and Luddendorf used the well-

communications (radio) during the *Blitzkreig* to enhance maneuverability in World War II, the improved descendants of these equipments made the overmanagement of the Vietnam battlespace not only possible, but arguably inevitable.[22]

It is important here to recognize the relationship between technology and leadership style. In both examples, communications aided decentralized execution, whereas the same technology was a hindrance in more centralized modes of leadership. Historically, improved data throughput has not supported more centralized control of tactical forces.[23]

Even more significantly, these examples show how such developments shape the commander as much as they are shaped by the commander. Tools are created to fulfill a need, but often subsequently shape the needs of the users.[24] In both cases cited, technologies introduced where C^2 was generally decentralized eventually facilitated shifts in leadership to centralized, and ultimately less effective, styles.

Increased information flow promotes these shifts for some very sensible reasons. The fundamental fear of uncertainty is both alleviated and compounded by increased volumes of data. Beaumont points out that:

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established telegraph networks to exercise very centralized control -- but were restricted in their own flexibility by the relative immobility of telegraph lines and stations.

[22] ibid., pp 189-260. German use of two-way instantaneous communications in the 1940s was largely a monitoring function in a tactically decentralized battlespace. The availability of data through radio and satellite channels during Vietnam led to the same sort of analytical processes and centralization of leadership seen during the trench warfare of World War I.

[23] Joseph A. Moore, "Gaining Order from Chaos: Will Automation Do It?" Research Paper, School of Advanced Military Studies, U.S. Army Command and General Staff College (Fort Leavenworth: 1993), p. 42.

[24] A'Hearn, p. II-39.

> "the increasing capacity of systems . . . may increase the tendency of staffs and commanders to demand from subordinates substantial amounts of data which have little utility other than to ease anxiety."[25]

Furthermore, due to career patterns, operational staff officers are often more comfortable with tactical matters than with operational art[26] and, under stress, will seek to assemble the data flowing from the tactical battlespace into familiar patterns. Additionally, the speed of communications allows the staff to react in real-time to tactical developments, providing the illusion of control.[27] Finally, in high-stakes political environments, centralized control is almost inevitable when tactical actions have strategic significance.[28]

The problem with centralized execution, regardless of the supporting technologies, is information overload, which creates backlogs in decision-making.[29] From Napoleon to McNamara, the pendulum swings between operational flexibility and operational rigidity have been abetted by improvements in C^2 technology. Innovations are utilized until they exceed the capacity of the users to exploit them well, then work-arounds are implemented. Many World War I generals, for example, were slaves of fixed telephones and telegraphs. General Marshall, on the other hand, used homing pigeons to reduce his reliance on these technologies and provide a highly personalized source of information.[30]

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[25] Roger Beaumont, *The Nerves of War: Emerging Issues in and References to Command and Control* (Washington: AFCEA International Press, 1986), p. 55.

[26] L. D. Holder, "Training for the Operational Level," *Parameters*, Spring 1986, p. 7.

[27] Snyder, p. 61.

[28] A'Hearn, p. II. 37.

[29] Paul D. Hughes, "Mercury's Dilemma: C3I and the Operational Level of War," Research Paper, School of Advanced Military Studies, U.S. Army Command and General Staff College, (Fort Leavenworth: 1988), p. 28.

[30] Munro, p. 79.

Stated simply: (1) leadership continually craves information;[31] (2) technology provides increased data, (3) leadership may then become less flexible and more centralized (". . . the highest commanders think they [are] in the cockpit . . ."[32]); until (4) a new "stasis" level is achieved using "directed telescopes;" but (5) the leadership begins to crave more information.

The "nose-in-the-cockpit" syndrome can occur at all levels, and is particularly tempting the farther removed from the battlespace. Systems to enhance command at the highest levels are generally more sophisticated than elsewhere in the chain of command (particularly in the nuclear era[33]), and this has aided recent increases in "remote control" leadership all the way up to the President.[34]

In present form, the "Warrior" strategy represents a risk of over-centralized leadership to the CINC. By increasing data throughput and multi-source, multi-path connectivity, this strategy is creating an institutional telescope of immense proportions, but one whose controls--the tools that *reduce* and manage the data -- will not arrive until later. The systems developed to support the commander "may determine the command style of the future by default."[35]

As in the past, an undisciplined increase in information flow, however temporary, is likely to have a predictable result. Command and control organizations served by this architecture are likely to tend towards inflexibility and centralized control. In an

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[31] Toffler, p. 183.

[32] Jack Broughton, *Going Downtown: The War Against Hanoi and Washington* (New York: Orion Books, 1988) quoted in Munro, p. 81.

[33] Snyder, p. 18.

[34] van Creveld, p. 237. Presidential involvement in 73% of 200 crises (1946-1975) was legally necessary in only 22% of the situations surveyed.

[35] Orr, p. 89.

environment already dominated by politically sensitive operations, an operational commander whose staff is principally experienced in tactical decision-making will be inexorably drawn towards the same leadership styles that have confounded others in the past.

V. "C4I FOR THE CINC"

"Assess the advantages in taking advice, then structure your forces accordingly...."
-- Sun-Tzu"[36]

To meet the needs of the commander, the C^2 process must meet several criterion already discussed:

- Enhance the use of force by avoiding errors, and optimize efficiency.
- Transport and *reduce* data into usable formats (fusion)
- Be disciplined and respond to the commander's needs
- Be flexible and avoid influencing the commanders style.

None of these requirements are incompatible with the "C^4I for the Warrior" strategy, *at the Objective Phase*. There is however, a critical period prior to attaining this goal during which the new joint C^4I architectures may have opposite effects, and ultimately influence the operational commander's ability to effectively command due to information overload.

This reinforces the need for *reduction* of information into knowledge that is timely, relevant and accurate for the needs of the commander. While timeliness and accuracy are addressed in the early phases, the question of relevance demands greater attention. The principle reason for fusing data is to provide the commander with an aggregate picture of the battlespace that is directly *relevant* to the decisions to be made.[37]

Dr. Conley, formerly of the Navy Staff, states that the "volume of influence" over which a commander exercises control should be "less than or equal to the volume of

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[36] Cleary, p. 48.
[37] Snyder, pp. 32-33.

perception in order to be effective."[38] By direct inference, the theater commander exerts influence over an *entire theater*. Where large amounts of direct battlespace information are immediately available, this would more than likely overwhelm the commander.

A more fine distinction would be in viewing volumes of influence as *successive* and not necessarily inclusive. Figure 1 illustrates this analogy.[39] There are aspects of the battlespace which the commander may not desire to observe, and should leave to subordinate commanders. In fact, while volumes of influence may *overlap*, there are distinct areas in which each command level should seek to influence only that which is immediately relevant.

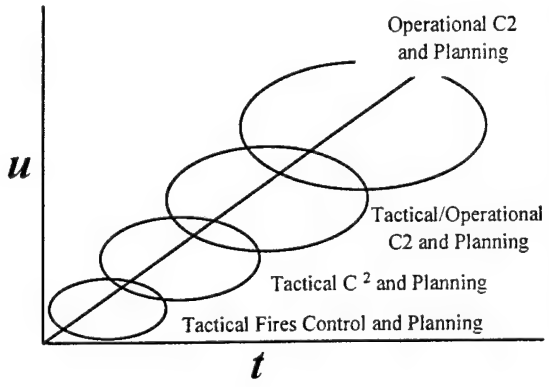

Fig. 1: NOTIONAL C^4 I FUNCTIONALITY

The x-axis represents timeliness of data and the y-axis the corresponding increase in uncertainty (for any single datapoint) over time. Within any given C^2 architecture, decision making functions tend to fall into domains of influence which are defined both by the information available as well as the ability to process the data.

The C^2 process takes place throughout the entire chain of command,[40] and the commander organizes subordinates to take advantage of their judgment and ability to give him what he needs. Commanders rely upon these people to reduce and make relevant the data from the battlespace. With a sudden increase in data however, even the best of staffs

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[38] Conley, p. 18.

[39] David Aland, "The Not-So-Digital Battlespace: C4I Interface Challenges", Unpublished Research Paper, Naval War College, (Newport: 1995). This "model" is of my own design.

[40] Joseph Wohl, "Force Management Decision Requirements for Air Force Tactical Command and Control", *IEEE Transactions on Systems, Man and Cybernetics*, September 1981, p. 620.

will be severely taxed, and staff sizes (already increased five-fold since 1945[41]) cannot continue to increase in order to cope.

There are two choices to alleviate the workload which the "C4I for the Warrior" strategy will make possible and the first is to increase the automated information processing capabilities of the staff. The need to automate aids for the commander, staff, and subordinate commanders has been the subject of study for some time. A Rand Corporation report has highlighted the need to "increase the Chief of Staff's ability to filter information,"[42] and General Powell has also noted that "software-controlled customizing of each command node is the goal."[43]

But automating manual tasks is tricky where decision-making processes are concerned, and particularly when the tasks are poorly quantified.[44] Furthermore, computerized fusion necessarily means *automating some decision-making as well.* Many military critics call such proposals "the Tom Clancy syndrome", and doubt that automation will ever replace the "man-in-the-loop."[45]

Continued progress in technology is unlikely to either reverse or significantly accelerate. Development in decision-theory automation, "fuzzy"-logic, chaos-theory, and intuitive modeling are progressing, but these tools remain relatively rudimentary, and will not provide immediate relief. While development of an automated C^2 architecture must be matched by the tools needed to control it, the architecture is leading.

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[41] van Creveld, p. 267.
[42] Kahan, Worley and Stasz; p.83.
[43] "Information Age Warriors", p. 370.
[44] Snyder, p. 93.
[45] Thomas Ricks, "Gingrich's Futuristic Visions for Re-Shaping The Armed Forces Worry Military Professionals", *The Wall Street Journal*, 8 February 1995, p. 16.

The second solution brings us back to *relevance*, determined not only by the commander's volumes of perception and influence, but by the *capacity* to reduce data to decision-relevant knowledge. This capability is measured both in how much the *staff* can assimilate, *and* the whole chain of command. It is here that the creep towards centralized leadership can and must be actively countered.

This necessarily implies that the CINC not only resist over-utilizing the advances in "C^4I for the Warrior," but also institutionalize the boundaries between volumes of influence throughout the entire chain of command. As the flow of information increases, the CINC will need to be more selective in the data reviewed, and very likely more *restrictive* in quantity. Greater reliance on subordinate levels of command is both the desired and likely result.

The process of selection cannot rely simply on a sort of selective digital deafness. Merely discarding data that may be superflous or irrelevant to one decision maker may deprive other levels of command of meaningful data. In the emerging infosphere, the danger of inadvertant loss of significant data rises with the quantity of data available. Judicious allocation of data to the level of command where it is *most relevant* becomes the central challenge.

It falls to the CINC to organize his command and control structures in such a way as to spread throughout the chain of command the tasks most relevant to each level *and* the information tools supporting those tasks. Furthermore, this division of labor must preclude "mutual interference" between subordinate levels by fixing the decision

thresholds at the lowest possible stratum[46] while [redacted] providing any subordinate the ability to wield a "directed telescope" when needed.

Until automated decision, fusion, and correlation aids match the increased connectivity and interoperability, it will be the CINC's organizational decisions that will dictate the effective use of the "Warrior" architectures more than the systems themselves. Niether can the CINC cannot rely on tomorrow's technologies to solve today's leadership challenges. The global infosphere is a "directed telescope" of considerable magnitude, but the CINC should not allow the tool to dictate methodology. Otherwise, we will have succeeded in nothing more than building a faster means of getting our noses stuck "in the cockpit."

[46] van Creveld, p. 270.

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